

TITLE: SYSTEM AND METHOD OF USING VARIABLE PULSES FOR SYMBOLOGY

BACKGROUND OF THE INVENTION

Field Of The Invention

The present invention relates generally to the use of character codes to telecommunicate data. More specifically, and in particular, the present invention comprises a system and method for the use of variable duration pulses and/or variable duration spaces between electronic or photonic pulses, each representing a different base 10 number, which are transmitted using an ultra wide band or fiber optic system.

Problems In The Art

Currently, computers create, store, and access data which is coded using the binary language of 1's and 0's. Computers routinely access binary coded files remotely via a telecommunication network. Computers and telecommunication networks use the same binary language to create, store, and access data. At the stroke of a key a computer transforms various forms of input into a numerical representation. Many different methods of transformation have been put into effect. Morse Code was perhaps the first such method to be widely used. Today, the majority of systems all use a binary language or code to transform various forms of input into numerical representations and vice versa.

Much like Morse Code, binary numbers use only two variants to represent vast quantities of textual data. For instance, in 7-bit ASCII code, the textual number "3" is represented in binary as "0110011" and the textual letter "A" is represented in binary as "1000001". Each bit in the seven bit representation screen is either a "1" or a "0".

Problems arose with the use of many different types of binary encoding. The many different types of binary coding were not consistent and the many types of human language resulted in different textual representations from the same set of binary numbers. For instance, ASCII and ISO 646 were used for English-language data, while ISO 2022, an extension of ISO 646, is used for Latin based scripts common in Europe which tend to employ various accent marks. This new standard became known as "Latin-1". Similarly, there is now "Latin-2", "Latin-3", etc.

A solution was sought. That solution has appeared in what has become known as "UNICODE". After several attempts at a multilingual system, UNICODE, short for

Unification Code, was developed to provide a unique number identifier to every possible piece of textual data. Using a 16-bit encoding means that code values are available for more than 65,000 characters. While this number is sufficient for coding the characters used in the major languages of the world, the UNICODE Standard and ISO/IEC 10646 provide the UTF-16 extension mechanism (called surrogates in the UNICODE Standard), which allows for the encoding of as many as 1 million additional characters without any use of escape codes. This capacity is sufficient for all known character encoding requirements, including full coverage of all historic scripts of the world.

Though UNICODE has become the multilingual code of choice for American manufacturers, several groups in the Far East have proposed and implemented a UNIX version of a multilingual code. This code uses an editor known as Mule, for MULTilingual Enhancement to GNU Emacs). This editor uses many escape sequences to provide a multilanguage capability.

No matter which multilingual code becomes the world-wide standard, all of them must be eventually converted into binary numbers for use on computers and transfer across networks and the internet. As the individual universal code numbers increase in size, so must their binary number representations. Further, if a system based on escape sequences is used, many levels of representation may be necessary. This, too, requires longer binary representations. Further, current mechanical drives, such as standard computer hard drives, store textual representations as binary numbers. Longer textual representations require longer binary representations which in turn requires more physical space.

The longer the binary representation, the longer the process time and transfer time for data. As most current applications use some type of buffering when transmitting data, the limited 1's and 0's of binary also require large areas in which buffering may take place. As more and more systems move to wireless methods of communications and storage, transfer and processing time will become critical. It is therefore desirable to provide a method of minimizing the size of data representations.

There is therefore a need for a character code and transmission system and method which avoids these and other problems.

Features Of The Invention

A general feature of the present invention is the provision of a method and system which overcomes the problems found in the prior art.

A further feature of the present invention is the provision of a method and system capable of transmitting and processing a larger amount of more relevant data per unit time.

Another feature of the present invention is the provision of a method and system which replaces the current binary coded symbols with variable duration electronic or photonic pulses.

A still further feature of the present invention is the provision of a system and method which modifies the current UNICODE standard character sets by representing the numbers, 0 through 9, with a single variable duration electronic or photonic pulse.

Another feature of the present invention is the provision of a method and system which modifies the UNICODE standard character sets for symbols other than numbers with a combination of variable duration electronic or photonic pulses.

A still further feature of the present invention is the provision of a system and method which modifies the current UNICODE standard character sets by representing the numbers, 0 through 9, with a single variable duration space between electronic or photonic pulses.

A still further feature of the present invention is the provision of a method and system which modifies the UNICODE standard character sets for symbols other than number with a combination of variable duration spaces between electronic or photonic pulses.

A still further feature of the present invention is the provision of a method and system which modifies the UNICODE standard character sets for symbols other than number with a combination of variable duration pulses and variable duration spaces between electronic or photonic pulses.

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A still yet further feature of the present invention is the provision of a method and system which modifies the UNICODE standard character sets for all symbols and numbers by time modulating the start position of an electronic or photonic pulse as related to its neutral position.

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Another feature of the present invention is the provision of a system and method which can improve buffering time and reduce needed buffering space.

These, as well as other features and advantages of the present invention, will become apparent from the following specification and claims.

SUMMARY OF THE INVENTION

The present invention relates generally to the use of character codes to telecommunicate data. More specifically, and in particular, the present invention comprises a system and method for the use of variable duration pulses and/or variable

duration spaces between electronic or photonic pulses, each representing a different base 10 number, which are transmitted using an ultra wide band or fiber optic system. Optical storage mediums such as, but not limited to, CD-ROMs and DVDs could also use variable length pits and/or variable length spaces between pits, each representing a different base 10 number. Thus, the present invention can represent the value contained in any word for any format used for music, graphics, data storage, video, etc. for CD, DVD, Laser Discs, etc., mediums.

Current UNICODE representations are listed in tables which may be stored electronically in a 256x256 array. A character code is assigned to each code element defined by the UNICODE standard. Each of these character codes is currently represented by a binary number. The present invention uses variable length pulses to represent all singular numerical digits 0 through 9. As each character in UNICODE is assigned a unique number, the variable duration pulses of the present invention send the actual number of the UNICODE character in an overall shorter string of numbers which may be read directly, rather than a string of binary numbers which must be further interpreted.

The coding system of the present invention is based upon a series of pulses transmitted and received over an ultra wide band and/or fiber optic system. Currently, Time Domain, Inc. has developed an impulse radio system which incorporates time modulated ultra wide band technology. Impulse radio systems are described in a series of patents, including U.S. Pat. No. 4,641,317 (issued Feb.3, 1987), U.S. Pat. No. 4,813,057 (issued Mar. 14, 1989), U.S. Pat. No. 5,363,108 (issued Nov. 8, 1994), and U.S. Pat. No. 6,031,862 (issued Feb. 29, 2000) all to Larry W. Fullerton. Other types of ultra wide band systems are described in U.S. Pat. 5,901,172 to Robert J. Fontana, et al, and U.S. Pat. 6,026,125 to J. Frederick Larrick, Jr., et al. These patent documents are herein incorporated by reference.

As a time modulated system sends out a signal or pulse, it varies the position of the pulse in time or offsets the pulse from its original location, thus varying the pulse to pulse interval on a pulse to pulse basis. Currently the interval which is varied is large enough to allow a series of pulses or a string to be offset as a group prior to the next pulse or string being sent.

Further, each pulse may be elongated to last for a predetermined and programmable length of time. Thus, the offset of the pulse may be used for additional security purposes rather than as a means with which to transmit data. The length of the pulse becomes the data which is sent. By varying the length of the pulse, data may be transmitted using more than the 0 or 1 used in binary language.

Ultra wide band systems can detect the start of a pulse, and the system may be programmed to listen for the end of the pulse which may vary in duration according to programming. In the preferred embodiment of the present invention ten variable duration pulses and/or ten variable duration spaces between pulses are used to represent numbers 0-9. For example, the number 1 is a pulse of 50 pico seconds in duration. Other numbers and their corresponding pulse durations are shown in Chart 1.

In an alternate embodiment of the present invention a constant duration pulse is broadcast at varying times from the pulse neutral position to represent numbers 0-9, as shown in Chart 8. This embodiment would have particular benefit in a time modulated, ultra wideband system.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

The present invention relates in general to a unique method for representing data used by the telecommunication and computer industries. More specifically and in particular, the present invention is a new standard symbology comprised of variable duration pulses and/or variable duration spaces between pulses that can be used in a variety of ways to represent ASCII and UNICODE symbols. These variable duration pulses and/or variable duration spaces between pulses can be electronic or photonic depending on the transmission media.

The present invention replaces the current de facto standard of binary coding of information for use by computers and telecommunications, by instead representing each number, 0 through 9, with a single variable duration pulse and/or variable duration space between pulses. The first embodiment of the present invention includes variable duration pulses and/or variable duration spaces between pulses representing numbers, 0 through 9, and combination of variable duration pulses and/or variable duration spaces between pulses to represent all other standard UNICODE symbols.

The system of the present invention includes an impulse radio transceiver which can generate a variable duration pulse and/or a variable duration space between pulses in the following manner. Combinations of numbers, 0 through 9, which represent bits of digital input data, such as ASCII or UNICODE, are stored in a memory unit. The digital output, numbers 0 through 9, would be assigned an address in a memory unit. As a result, upon being addressed, a discrete output number would be fed to a Digital/Analog converter unit. The Digital/Analog converter unit would then output an analog signal proportional to the input number (see Chart 1) which would then be fed to a trigger generator. As an example, the trigger generator, e.g., an avalanche mode operated transistor, would provide a sharply rising electrical output at the 10,000 Hz rate or a like response of light output, e.g., by ultraviolet laser, dependant upon the transmitter to be driven.

An input signal, which is a proportionally variable duration pulse and/or a variable duration space between pulses, representative of a number, 0 through 9, is fed to a trigger generator and rapidly turns "on" a switch for a proportional amount of time, thus creating electronic or photonic pulses. The switch, for example, may be an electrically operated or light operated switch, such as a diamond switch in response to an ultraviolet laser triggering device via fiber optic. Importantly, it must be capable of switching in a period of a nanosecond or less. It is then switched "on" to discharge a broadcast antenna which was earlier charged from a power source, for example in the range of 100 to 5,000 volts. The switch may also discharge its output to a fiber optic cable. Such output allows data to travel at the speed of light rather than the speed of sound. Further, through the use of a repeater, data stored in the form of light pulses and/or spaces therebetween may be stored on a loop of fiber optic cable.

Storage on a loop of fiber optic cable may occur by turning a repeater "on" and pulses of data may be accessed at any time by viewing the looped signal or pulses input to the repeater through well known programming methods. The data may be altered by adjusting the output of the repeater through well known programming methods to incorporate the desired changes, thus saving the data to the loop.

Similarly, the output of the switch may be used to generate pits on a compact or digital versatile disk or any other type of optical storage media. The recording lasers which currently are pulsed for constant durations of time to represent a "1" or a "0" are instead

pulsed for a variable amount of time, thus generating pits, and spaces between pits, which are of varying lengths representing data symbology based on variable duration pulses and/or variable duration spaces.

These proportionally variable duration pulses and/or variable duration spaces between pulses, are detected by an impulse radio receiver or other transceiver that has been programmed to capture and interpret such pulses and/or spaces. The present invention uses variable duration pulses and/or variable duration spaces between pulses for coding to achieve a more efficient universal character set. Single variable duration pulses and/or variable duration spaces between pulses that are mathematically significant and relate to the numbers, 0 through 9, are used in conjunction with a character set like ASCII, or an expanded universal character set like UNICODE.

The first embodiment of the present invention includes single variable duration pulses and/or variable duration spaces between pulses representing numbers, 0 through 9, and combinations of variable duration pulses and/or variable duration spaces between pulses to represent all other standard UNICODE symbols.

FIRST EMBODIMENT

The first embodiment of the present invention is a modification of the UNICODE standard symbology. This modification represents the numbers, 0 through 9, using only a single variable duration pulse and/or variable duration space between pulses. Computers using this modification perform base 10 math. Base 10 math is more efficient and up to eight times faster than the base 2 math now required with binary symbology. All other standard UNICODE symbols would be represented by combinations of variable duration pulses and/or variable duration spaces between pulses as opposed to a sixteen digit binary number. The main advantage of UNICODE is a standard symbol set can be used by computers for universal data interchange. One example of a scheme to use single variable duration pulses and/or variable duration spaces between pulses to represent numbers, 0 through 9, is shown in Chart 1:

Chart 1

NUMBER	PULSE DURATION AND/OR SPACE DURATION BETWEEN PULSES
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	(PICO-SECONDS)
1	50
2	100
3	150
4	200
5	250
6	300
7	350
8	400
9	450
0	500

It is important to note that in the scheme represented in Chart 1, the following mathematically significant relationship exists:

Integer (1-9) = integer X base pulse duration (50 pico-seconds)

Zero = 500 pico-seconds

Even though Chart 1 depicts the above relationship, it should be obvious to those skilled in the art that any interval of pulse timing can be used. For example, the base pulse duration and/or space duration between pulses could be 40 pico-seconds, or 100.7 pico-seconds, or any other duration.

This relationship can be used for base 10 computing without converting from any of the commonly used math schemes such as, base 2, octal or hexadecimal in a computer.

The example below in Chart 2, illustrates adding the numbers 347 to 226 to 151 by summing the total pulse duration and/or space duration between pulses in the ones column, the tens column, and the hundreds column.

Chart 2

FUNCTION	PULSE AND/OR SPACE COUNT (HUNDREDS)	PULSE AND/OR SPACE COUNT (TENS)	PULSE AND/OR SPACE COUNT (ONES)
347	3	4	7
+226	2	2	6

+151	1	5	1
Accumulated Total	6	11	14
Interpreted As	6(100s)	1(100s) 1(10s)	1(10s) 4(1s)
Answer Analog = 724	7(100s)	2(10s)	4(1s)

Chart 3 represents information contained in Chart 2 using current binary coding methods.

Chart 3

FUNCTION	EIGHT BIT BINARY (HUNDREDS)	EIGHT BIT BINARY (TENS)	EIGHT BIT BINARY (ONES)
347	00000011	00000100	00000111
+226	00000010	00000010	00000110
+151	00000001	00000101	00000001
Accumulated Total	00000110	00001011	00001110
Interpreted As	00000110(100s)	00000001(100s) 00000001 (10s)	00000001(10s)) 00000100 (1s)
Answer Analog = 724	7(100s)	2(10s)	4(1s)

As an example, in Chart 2 the numbers 347, 226, and 151 are each represented by 3 pulses and/or spaces between pulses of data. In Chart 3 the numbers 347, 226, and 151 are each represented by 24 bits, of data. Comparing the amounts of data in Charts 2 and 3, it is obvious the present invention's variable pulsed symbology method requires fewer pulses and/or spaces than the standard binary number method, by a ratio of 1 to 8, or $1/8^{\text{th}}$. The inverse of this ratio would indicate that the amount of relevant information processed or transmitted could increase by a factor of 8. This increase in relevant information relates to more efficient use of symbols in computers and telecommunications.

If the numbers in Chart 3 were represented by the UNICODE standard character set, the numbers, 0 through 9 would be represented by sixteen digit binary numbers. Therefore, the ratio of pulses and/or spaces to bits in this scenario would be 1 to 16, or $1/16^{\text{th}}$. The

inverse of this ratio would indicate that the amount of relevant information processed or transmitted could increase by a factor of 16.

Another application of the present invention would include Internet Protocol (IP) addresses used in telecommunications. Current IP addresses consist of 32 bits of binary numbers. The present invention can represent an IP address with 12 variable duration pulses and/or variable duration spaces between pulses.

There are more computing operations required to process binary numbers mathematically than when using base 10 numbers. The exact number of operations will differ with each computation due to the number of values involved or the operation that is being computed. Using the method described in the present invention, the number of processing operations will be fewer when using variable pulse symbology to represent numbers in base 10.

The present invention is a modification to UNICODE standard character sets described in *The UNICODE® Standard A Technical Introduction*. This modification changes the representation of numbers, 0 through 9, in any version of UNICODE standard character sets from a sixteen digit binary number to a single variable duration pulse and/or variable duration space between electronic or photonic pulses. All other symbols in any UNICODE standard character set are represented by combinations of variable duration pulses and/or and/or variable duration spaces between pulses. Chart 4 illustrates a sample of UNICODE symbols other than numbers, 0 through 9, represented by a sixteen-digit binary (0,1) number, in comparison with a modified version using combinations of variable duration pulses and/or variable duration spaces between pulses.

Chart 4

SYMBOL	UNICODE REPRESENTATION (CURRENT)	UNICODE REPRESENTATION (PROPOSED)
A	0000000001000001	00065
I	0000000001001001	00073
S	0000000001010011	00083

The present invention does not affect computer clock speed, but simply allows more relevant bits of information to be processed per unit of time or transmitted over a telecommunication network per unit of time. Chart 4 demonstrates that current UNICODE

representation of data is sixteen bits long. The corresponding UNICODE symbol using the present invention's variable duration pulse scheme based on Chart 1, consists of five pulses and/or spaces between pulses. This represents an apparent speed increase for computing or telecommunication of 16 to 5, or 3.33 times faster for textual based operations.

The second embodiment of the present invention are single variable duration pulses and/or variable duration spaces between pulses representing numbers, 0 through 9, and combinations of variable duration pulses and/or variable duration spaces between pulses to represent all other standard ASCII symbols.

SECOND EMBODIMENT

This modification changes the representation of numbers, 0 through 9, in any version of ASCII standard character sets from a eight digit binary number to a single variable duration and/or variable duration spaces between pulses electronic or photonic pulse. All other symbols in any ASCII standard character set are represented by combinations of variable duration pulses and/or variable duration spaces between pulses. Chart 5 illustrates a sample of ASCII symbols other than numbers, 0 through 9, represented by a eight digit binary (0,1) number, in comparison with a modified version using combinations of variable duration pulses.

Chart 5

SYMBOL	ASCII 8859-1 REPRESENTATION (CURRENT)	ASCII 8859-1 REPRESENTATION (PROPOSED)
A	01000001	065
I	01001001	073
S	01010011	083

The present invention does not affect computer clock speed, but simply allows more relevant bits of information to be processed per unit of time. Chart 5 demonstrates that current ASCII representation of data is eight bits long. The corresponding ASCII symbol using the present invention's variable duration pulse scheme based on Chart 1, consists of three variable duration pulses and/or variable duration spaces between pulses. This represents an apparent speed increase for computing or telecommunication of 8 to 3, or 2.67 times faster for textual based operations.

The two embodiments of the present invention describes three methods of employing variable duration symbology to represent data used by computers and/or telecommunication networks. In the first method, only variable duration pulses are used to represent data. In the second method, only variable duration spaces between pulses are used to represent data. The third method uses a combination of both variable duration pulses and variable duration spaces between pulses to represent data.

In the third method, there are two alternatives in which a combination of both variable duration pulses and variable duration spaces between pulses can be used to represent data.

The first alternative method is called cascading. This is defined as variable duration pulses and variable duration spaces between pulses alternating to represent data. As an example, in Chart 6 the UNICODE character 15461 would be represented by the following cascade of variable duration pulses and variable duration spaces between pulses used to represent the data.

Chart 6

UNICODE CHARACTER NUMBER	PULSE DURATION AND/OR SPACE DURATION BETWEEN PULSES (PICO-SECONDS) (SEE CHART 1)	PULSE OR SPACE
1	50	PULSE
5	250	SPACE
4	200	PULSE
6	300	SPACE
1	50	PULSE

The second alternative method for using a combination of variable duration pulses and variable duration spaces between pulses is called double-coding. This is defined as the variable duration pulses used to represent a UNICODE character, and the variable duration spaces between pulses used to represent meta data. As an example, in Chart 7 the UNICODE character number 15461 would be represented by the variable duration pulses, and meta data number 6739 is represented by the variable duration spaces between pulses. This meta data, or "XML-type" tagging would be used to drive look-up tables in which the

number represented by the variable duration spaces between pulses was equivalent to a tag word, not just a single character. Using only the four variable duration spaces between pulses would allow a table of 9,999 meta data or “XML-type” tags to be created. If an extra pulse, or an “anchor pulse” were used, five variable duration spaces between pulses would allow a table of 99,999 meta data or “XML-type” tags to be created, etc.

Extending the use of encoding entire words as described above with the meta tags could also be applied to combinations of UNICODE characters which make up words. As an example, an eight bit number represented by eight variable duration pulses and/or variable duration spaces between pulses would represent 99,999,999 words. As an example, the word “elephant” would require eight UNICODE characters, or 128 bits of data. By using an eight bit number in a look-up table, such as 19876543 to represent the word “elephant” would save 120 bits of data.

Chart 7

UNICODE CHARACTER NUMBER	META DATA NUMBER	PULSE DURATION AND/OR SPACE DURATION BETWEEN PULSES (PICO-SECONDS) (SEE CHART 1)	PULSE OR SPACE
1		50	UNICODE PULSE
	6	300	META SPACE
5		250	UNICODE PULSE
	7	350	META SPACE
4		200	UNICODE PULSE
	3	150	META SPACE
6		300	UNICODE PULSE
	9	450	META SPACE
1		50	UNICODE PULSE

In an alternate embodiment of the present invention a constant duration pulse is broadcast at varying times from the pulse neutral position to represent numbers 0-9, as shown in Chart 8. This embodiment would have particular benefit in a time modulated, ultra wideband system

Chart 8

NUMBER	PULSE START TIME DIFFERENCE FROM NEUTRAL POSITION OF THE PULSE (PICO-SECONDS)
1	50
2	100
3	150
4	200
5	250
6	300
7	350
8	400
9	450
0	0

It is important to note that in the scheme represented in Chart 1, the following mathematically significant relationship exists:

Integer (0-9) = integer X pulse time difference (50 pico-seconds)

Even though Chart 1 depicts the above relationship, it should be obvious to those skilled in the art that any interval of pulse time difference can occur. For example, the pulse time difference could be 40 pico-seconds, or 100.7 pico-seconds, or any other difference from its neutral position.

Using this alternative method of representing the numbers 0-9 supports the examples of Charts 2, 3, 4, and 5 which demonstrate base 10 math and new representations for UNICODE and ASCII symbols.

The present invention also provides for an alternate method of inputting variable duration symbology into a computer using a new bar code symbology based on variable duration pulses and/or variable duration spaces between pulses, as described in Chart 1.

The bar code symbology would have various width bars and spaces that correspond mathematically to the variable duration pulse and variable duration spaces between pulses described in Chart 9.

Chart 9

NUMBER	VARIABLE DURATION PULSE AND/OR VARIABLE DURATION SPACE BETWEEN PULSES (PICO-SECONDS)	WIDTH OF BAR CODE BAR AND/OR SPACES BETWEEN BARS (INCHES)
1	50	.010
2	100	.020
3	150	.030
4	200	.040
5	250	.050
6	300	.060
7	350	.070
8	400	.080
9	450	.090
0	500	.100

The width of the bar code bars and/or spaces between bars in Chart 8 are representative of one scheme. One skilled in the art will recognize that other bar code bar widths and spaces between bars would be applicable.

The present invention will require fewer data conversions than are now required to capture bar coded data and convert into analog data that is human readable. Currently, a bar code reader captures bar coded data, converts it to an ASCII symbol, then to a binary coded number, then back to ASCII, then to a human readable symbol. The present invention will enable a bar code reader to capture bar coded data using the new symbology, convert it directly to a variable duration pulse and/or variable duration space between electronic or photonic pulses, then to a human readable symbol. The new bar code symbology is more efficient than existing bar code symbologies, as it will use two bars and one space between bars to represent an ASCII symbol, versus the five bars and four spaces that are currently required using Code 39, for example.

A general description as well as a preferred embodiment of the present invention has been set forth above. Those skilled in the art to which the present invention pertains

will recognize and be able to practice additional variations in the methods and systems described which fall within the teachings of this invention. Accordingly, all such modifications and additions are deemed to be within the scope of the invention.

100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000